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R_b and R_c Crises

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Abstract

The R_b and R_c crises described by Kaoru Hagiwara in hep-ph/9512425 [2] can be resolved by the T-quark mass value of 130 GeV and the $\alpha_s(M_Z)$ value of 0.106 of the $D_4 - D_5 - E_6$ model described in hep-ph/9501252 [5] and quant-ph/9503009 [6].

1 Introduction.

During 1995, precision electroweak data have confirmed the predictions of the Standard Model, with no new physics, with the possible exception of the two observables R_b and R_c.

In his recent review, Kaoru Hagiwara [2] has described the situation in detail, assuming the validity of the CDF value of the Truth quark mass of about 175 GeV.

Hagiwara [2] also notes that, although $\alpha_s \sim 0.12$ is favored from electroweak data, some low-energy measurements favor lower values $\alpha_s \sim 0.11$. (For more extended discussion of the α_s situation, see Shifman [3].)

The purpose of this paper is to show that the data for R_b and R_c are consistent with the Standard Model, as described by the $D_4 - D_5 - E_6$ model [4, 5, 6], without the need for new physics beyond the Standard Model such as technicolor, extended technicolor, or conventional supersymmetry.

2 R_b Crisis.

Kaoru Hagiwara in hep-ph/9512425 [2] says that precision electroweak data imply that R_b, the partial Z_0 boson width ratio of $b\overline{b}$ decay to total hadronic decay, is about 3% larger than Standard Model predictions with Truth quark mass in the range of the CDF value of about 175 GeV.

Donoghue, Golowich, and Holstein [1] say (at p. 461)
"Interestingly, however, a more complete calculation reveals
a slight *decrease* to occur in the decay rate $\Gamma_{Z_0 \to b\overline{b}}$
as m_t grows."

Since the $D_4 - D_5 - E_6$ model [4, 5, 6] predicts a Truth quark Mass of about 130 GeV, as opposed to the CDF value of about 175 GeV,
equation 1.17 on p. 436 of [1]

$$\Delta\rho \simeq 0.006 \times \left(\frac{m_t}{140GeV}\right)^2 \tag{1}$$

and equation 5.19 on p. 461 of [1]

$$(\Delta\rho)^{b}_{nonuniv} = -\frac{4}{3}\Delta\rho - \frac{\alpha}{4\pi s_w^2}\left(\frac{8}{3} + \frac{1}{6c_w^2}\right) ln\frac{m_t^2}{M_W^2} \tag{2}$$

can be applied to the $D_4 - D_5 - E_6$ model [4, 5, 6] to give an R_b value about 2.5% larger than R_b based on the CDF value of the Truth quark mass.

This shows that the $D_4 - D_5 - E_6$ model [4, 5, 6] is consistent with the Standard Model value of R_b.

3 R_c Crisis.

Hagiwara's Fig. 3 [2] shows that if R_c, the partial Z_0 boson width ratio of $c\overline{c}$ decay to total hadronic decay, is fixed at the Standard Model value, then the precision electroweak data imply that $\alpha_s(M_Z)$, the color force coupling constant at the energy of the Z_0 mass, is about 0.104 ± 0.08.

Since the $D_4 - D_5 - E_6$ model [4, 5, 6] value of $\alpha_s(M_Z)$ is about 0.106, the $D_4 - D_5 - E_6$ model [4, 5, 6] is consistent with the Standard Model value of R_c.

References

[1] J. Donoghue, E. Golowich, and B. Holstein, *Dynamics of the Standard Model*, Cambridge (1992).

[2] K. Hagiwara, hep-ph/9512425.

[3] M. Shifman, hep-ph/9511469.

[4] F. Smith, WWW URL http://galaxy.cau.edu/tsmith/TShome.html and WWW URL http://www.gatech.edu/tsmith/home.html.

[5] F. Smith, *Gravity and the Standard Model with 130 GeV Truth Quark from $D_4 - D_5 - E_6$ Model using 3×3 Octonion Matrices*, preprint: THEP-95-1; hep-ph/9501252.

[6] F. Smith, *Standard Model plus Gravity from Octonion Creators and Annihilators*, preprint: THEP-95-2; quant-th/9503009.